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Claim 1 (previously presented). A thermally-integrated water-gas shift reactor for converting reformat gases including carbon monoxide in the presence of steam to form carbon dioxide and water comprising, in combination,

- a) a centrally located waste-heat recovery steam generator for the recovery of exothermic reaction heat to generate steam,

- b) an outer region extending at least part way about said waste-heat recovery steam generator,

- c) a catalyst bed located within said outer region, and through which reformat gases flow, all of said bed extending only helically and about the steam generator, there being flow guide surfaces extending helically adjacent the catalyst to direct all gases to flow only helically through the helical bed, the bed located entirely outside the generator, said bed being a single bed and continuous in the helical direction of guided flow about the steam generator located centrally in the reactor.

- d) the outer region being in heat transfer communication with the steam generator and operating to maintain the catalyst bed within a predetermined temperature range for operation of a water-gas shift reaction producing said exothermic reaction heat.

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Claim 2 (previously presented). The combination of claim 1 wherein the waste heat steam generator operates at temperatures in one of the following ranges: 360°F to 450°F, and 385°F to 400°F, that is optimum for conducting the water-gas shift reaction.

Claim 3 (previously presented). The combination of claim 1 wherein said bed includes a Cu/Zn catalyst which is contained in space defined by said outer region, and there being an inner wall adjacent said space and that is in thermal contact with a boiling water fluid in said generator.

Claim 4 (previously presented). The combination of claim 3 wherein the boiling water fluid is located proximate the bed to heat the bed during start-up.

Claim 5 (previously presented). The combination of claim 3 wherein the catalyst bed extends helically about said waste heat recovery steam generator to transfer heat to the boiling water fluid.

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Claim 6 (previously presented). The combination of claim 1 wherein the flow guide surfaces comprise heat transfer fins projecting in said bed to enhance the rate of heat transfer to and from the catalyst bed.

Claim 7 (previously presented). The combination of claim 2 including inner and outer walls for defining annular space, containing said helical bed, and wherein the flow guide surfaces comprise a helical coil at said space to conduct and increase the velocity of the gases as they flow helically through the catalyst helical bed and to enhance the rate of heat transfer to and from the catalyst bed, said space being between 1 and 2 inches wide to minimize temperature differentials between the outer and inner walls, and wherein the gases have hourly space velocity in the range of 500hr⁻¹ to 2000hr⁻¹.

Claim 8 (previously presented). The combination of claim 1 wherein the catalyst bed is sufficiently close to said generator to be maintained in one of the following ranges: between 370°F and 550°F, and between 400°F and 450°F.

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Claim 9 (previously presented). The combination of claim 3 including an outside wall spaced from said wall, and wherein the space between said walls is between 1 and 2 inches wide to minimize temperature differentials between the outside and inside walls.

Claim 10 (previously presented). The combination of claim 3 wherein the bed has helical length characterized in that the gases have hourly space velocity in the range of 500hr⁻¹ to 2000hr⁻¹.

Claim 11 (previously presented). The combination of claim 1 wherein the waste heat steam generator contains one or more heat transfer conduits that transfer heat from combustion products to a boiling water fluid for the purpose of generating steam.

Claim 12 (previously presented). The combination of claim 1 wherein the steam generator includes an upright vessel, said outer region having an upper level inlet flowing reformat gases into the catalyst bed, the reformat gases including carbon monoxide, and said region having a lower level outlet, a heat transfer

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conduit or conduits extending within said vessel and immersed within boiling water contained in said vessel inwardly of said catalyst bed, said conduit or conduits operable for transfer of heat to the boiling water, for generating steam exiting from said vessel.

Claim 13 (cancelled).

Claim 14 (cancelled).

Claim 15 (previously presented). In combination:

- a) a centrally located steam generator,
- b) and means including catalyst all of which extends only in a substantially helical path about the steam generator, and in heat transfer relation with the generator,
- c) said catalyst receiving gases all of which flow along said path and react in the presence of the catalyst at between 400°F to 550°F to produce exothermic heat that is transferred laterally of said path to the generator.